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(54) **Perfected bending method for bending machines and relative bending machine**

Verbessertes Biegeverfahren und Biegemaschine zu dessen Durchführung

Système de pliage amélioré et machine à plier pour son exécution

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Description

FIELD OF APPLICATION

[0001] This invention concerns a perfected bending method for bending machines and a relative bending machine as set forth in the main claims.

[0002] The method is applied in machines used for the bending and shaping of metal shapes, particularly, but not only, of round pieces used for reinforcement purposes in constructions of reinforced concrete.

[0003] Particularly, but not exclusively, the invention is applied in bending and/or shaping machines with a horizontal or substantially horizontal working plane.

[0004] Hereinafter, for simplicity of explanation, we shall refer to bending machines for round pieces, but the invention may be applied to any kind of bending/shaping machine whatsoever.

[0005] Moreover, hereinafter we shall refer to round piece, but the section of the metal bar may be of various types, such as three-lobed, square, hexagonal, oval, etc.

STATE OF THE ART

[0006] The state of the art covers bending machines for round pieces for reinforcement purposes comprising at least a drawing assembly associated with at least a bending assembly and with a shearing assembly used to make brackets and/or bars shaped according to pre-defined angular or polygonal geometries.

[0007] The drawing assembly normally comprises at least a drawing device consisting of one or more pairs of counter rotating rolls aligned on a perpendicular axis with respect to the longitudinal axis of the round piece in transit.

[0008] In the case of round pieces fed from a reel, the drawing assembly normally also comprises straightening means placed upstream, downstream or both upstream and downstream of the drawing device.

[0009] In such bending machines, the round piece is often subject to rotations and lengthwise torsions along its axis which may cause considerable problems in the subsequent bending step.

[0010] This tendency to rotate and/or twist on its own axis derives from many factors such as rolling, winding, unwinding, pressure of the drawing rolls, etc.

[0011] Another cause which accentuates the structural tensions and problems relating to the drawing of the round piece is that the shape of the section is not constant.

[0012] There are sections where the round piece becomes almost oval in section, or at least where there are variations in the section, and this causes drawing problems which produce further axial twisting of the round piece as it advances. The axial twisting or rotation of the round piece have their effect on the position of the bends already made, as these tend to modify their position and lie at an angle on the working plane of the machine.

[0013] In other words, the bends already made tend to become detached and rise up with respect to the working plane of the machine as the round piece, as it is fed forwards in order to make the subsequent bends, gradually tends to twist and rotate on its axis.

[0014] The angular modifications to the plane on the already formed bends lie make it extremely difficult to obtain a correctly shaped product, and therefore to correctly position the first formed bends on the same plane as those made subsequently; this causes the formation of shaped brackets or bars which are inferior in quality because they are not planar.

[0015] Therefore it is very often necessary to discard these products and repeat the operations to form them, which causes a considerable increase in production costs and times.

[0016] In order to solve these problems, various solutions have been proposed, but they have not been efficacious, as they need complex and bulky equipment or require very high driving forces, with a consequent increase in production and/or management costs of the bending machines.

[0017] The state of the art includes CH-A-336349 which describes a device to form stirrups for reinforcement purposes; the device comprises in sequence a straightening device consisting of two series of rollers orthogonal to each other, a drawing device including rollers which feeds step-by step the wire which is to be bent, a shears, two bending assemblies and a device to discharge the stirrups when they are formed.

[0018] The drawing device is located upstream of the bending assemblies and is associated with a cam mechanism. Therefore, during the feed step, the rollers press on the wire to be drawn with great pressure (Fig. 3) whereas, during the bending step, they are only in contact with the wire (Fig. 5).

[0019] However, since the drawing device is upstream of both the bending assemblies, and since the rollers are arranged in contact with the wire during the bending step, the wire itself is not able to rotate and fall on the working plane if an angular modification of its position occurs as the bending operations proceed.

[0020] Moreover, there are no means to limit the lifting of the wire during bending and prevent it from turning over if the lifting of the bent portion is more than 90° with respect to the working plane.

[0021] The teachings of this document, therefore, do not obviate the shortcomings described above.

[0022] The present applicant has tested and embodied this invention to overcome these shortcomings and to achieve further advantages.

DISCLOSURE OF THE INVENTION

[0023] The invention is set forth and characterised in the main claims, while the dependent claims describe variants of the idea of the main embodiment.

[0024] The purpose of the invention is to provide a per-

fectured bending method, to be applied to bending machines for round pieces, advantageously but not only round pieces for reinforcement purposes, and to other types of bending machines, which will allow the twisting movements made by the round piece to be recovered and so that all the bends lie substantially on the same plane. The invention refers also to a bending machine to perform the method.

[0025] A further purpose of the invention is to provide a method and a relative bending machine which will allow shaped brackets and bars of high quality to be made, characterised by great planarity, without modifying substantially the basic structure of the bending machine.

[0026] The bending method according to the invention uses a bending machine of a substantially conventional type comprising a drawing device, consisting of one or more pairs of rolls, cooperating with at least a bending assembly and a mating shearing assembly.

[0027] In the event that the machine has two bending assemblies to make bends upstream and downstream, the drawing device is arranged at an intermediate position between the two bending assemblies.

[0028] According to the invention, the bending machine, downstream of the bending assembly and substantially on the same axis as the axis of feed of the round piece, has an element to limit the lift of the front part of the round piece which has already been bent.

[0029] The limiting element is arranged above the plane on which the round piece lies as it passes, and defines between itself and the working plane of the machine a vertical transit space which is little more than the size of the section of the round piece.

[0030] The transit space defined by the limiting element can also have a height coherent with two round pieces or more, according to the applications and the number of round pieces bent at the same time.

[0031] In the preferred embodiment, the limiting element consists of a metallic body, flat or shaped, and extending for a certain lengthwise section above the working plane of the machine, or the bending plane of the round piece which is to be shaped.

[0032] According to a variant, the limiting element is associated with actuating means which can lift it to different heights with respect to the bending plane of the round piece, and can possibly discharge it from the transit seating of the round piece.

[0033] This solution is particularly advantageous because it is possible thereby to adapt the arrangement of the limiting element to the number of round pieces which are to be bent simultaneously. This solution moreover makes it possible to extract the shaped round piece more easily when bending is concluded, and to carry out maintenance operations on the bending machine with greater facility.

[0034] When the round piece is fed, it is at least partly contrasted, in its tendency to rotate and twist on its axis, due to the interference which the limiting element arranged above the working plane of the machine and at

a defined height therefrom, exerts on the bend or bends already made.

[0035] This contrast causes the section of the round piece which has already been bent downstream of the drawing device to be maintained in a position of substantial proximity to the working plane of the machine.

[0036] According to the invention, at the end of the feeding step which precedes one or more bending steps, according to the requirements which arise from time to time, the rolls of the drawing device, and possibly the other gripping and/or contrasting elements acting on the round piece, are opened and removed from the round piece, thus stopping, at least for a moment, the clamping action and lateral contrast on the round piece.

[0037] When the clamping and contrasting action on the round piece is interrupted, this causes the already made and partially lifted bends to fall, due to their own weight, onto the working plane of the machine, where they therefore tend to assume a planar position resting on the working plane.

[0038] The bends falling cause the round piece which still has to be bent to be taken back to its correct position on the working plane, since the presence of the limiting device located above prevents it from lifting more than 90° with respect to the working plane and therefore prevents it from overturning.

[0039] Having obtained this effect, the rolls of the drawing device and the other possible gripping and contrasting means are closed on the round piece so that the cycle can continue.

[0040] The drawing device may open and close on the round piece before each bend, or for some of them, according to the type of round piece being worked and/or the type of product to be obtained.

[0041] The method and the machine according to the invention makes it possible to obtain shaped brackets and/or bars with a high level of planarity by using simple equipment without modifying the general structure of the machine and without reducing productivity.

ILLUSTRATION OF THE DRAWINGS

[0042] The attached Figures are given as a non-restrictive example and show a preferential embodiment of the invention as follows:

Fig. 1 shows a diagram of a bending machine using the perfected bending method according to the invention;

Fig. 2 shows a section from A to A of Fig. 1;

Fig. 3 shows a section from B to B of Fig. 2.

DESCRIPTION OF THE DRAWINGS

[0043] The reference number 10 in the figures denotes generally the bending machine for round pieces 11 for reinforcement purposes using the perfected bending method according to the invention.

[0044] The following description describes the case where the bending machine 10 works a single round piece 11 at a time, but it is the same case when several round pieces 11 are worked together, one on top of the other.

[0045] The bending machine 10 is equipped with a drawing device 12 comprising a pair of rolls 15 arranged aligned substantially perpendicular to the round piece 11 in transit.

[0046] In this case, the drawing device 12 cooperates with two bending assemblies, the first 13a and the second 13b, arranged respectively upstream and downstream thereof, and with a shearing assembly 14 arranged upstream of the first bending assembly 13a.

[0047] The bending assemblies 13a, 13b shown are of the type with a rotary plate 18 and include a contrasting pin 16 and a bending pin 17.

[0048] The bending machine 10 comprises, in this case, a limiting element 20 which extends lengthwise, substantially on an axis with the round piece 11 which is to be bent, and for a defined section, downstream of the second bending assembly 13b.

[0049] The limiting element 20 lies on a plane at a desired height above the working plane 19 of the machine 10, or the bending plane of the round piece 11.

[0050] In this case, the limiting element 20 consists of a metal shape of an open section comprising an upper face 20a and a side face 20b.

[0051] According to variants which are not shown here, the limiting element 20 has a transverse section which may be arched, rectangular or of another desired shape.

[0052] The limiting element 20, in this case, pivots horizontally with respect to the working plane 19, in correspondence with its side face 20b, by means of a hinge 21.

[0053] In the embodiment shown here, the movement of the limiting element 20 is obtained by means of two actuators 22 hinged at one end to the upper face 20a of the limiting element 20 and at the other end to the working plane 19.

[0054] At the beginning of the operative cycle, the rolls 15 of the drawing device 12 cause the round piece 11 to advance until it reaches the positions programmed for the first bends to be made.

[0055] At this stage, the rolls 15, in position "I", exert a high compression on the round piece 11; this compression, because of the structural tensions which have been accumulated by the round piece 11, tend to make it twist and rotate on its axis.

[0056] The axial twists and rotation cause the bends which have already been made to rise up, downstream of the drawing device 12.

[0057] In this case, the lifting of the bends which have already been made is contained by the limiting element 20 as the upper face 20a of the limiting element 20 comes into contact with the section of round piece 11 which has already been bent.

[0058] This limits the lifting action of the round piece 11 and maintains the already bent section of the round

piece at a level near to the working plane 19, or in any case less than 90° with respect to the working plane and such as to prevent it from turning over.

[0059] Since the position of the limiting element 20 is adjustable, it is possible to adapt the position thereof to the step and/or the type of bending to be carried out, or also to the bulk of the bends already made; it also allows the limiting element 20 to be discharged from the line of transit of the round piece 11 so that the final product obtained may be extracted more easily or for maintenance operations to be carried out.

[0060] At the end of the feed and positioning of the round piece 11 which precedes bending, the rolls 15 of the drawing device 12 are taken from the position "I", where they are closed over the round piece 11, to a partially open position "II" (shown by a line of dashes) wherein they are taken to a position of non-contact and therefore release the round piece 11.

[0061] Any contrasting and/or gripping means placed upstream or downstream of the drawing device 12 also open so as to completely release the round piece 11 from lateral contact.

[0062] This lateral release causes the section of round piece 11 which has already been bent to fall due to its own weight, downstream of the drawing device 12, which is therefore returned to a resting position on the working plane 19 of the machine 10.

[0063] Before the bend is made, the rolls 15 are repositioned in the closed position "I" so as to clamp the round piece 11, thus acting as a contrast to the bending, and then, once bending has been completed, so as to draw it into the position corresponding to the next bending.

[0064] This procedure, of opening and then closing the rolls 15 on the round piece 11, can be carried out before all the bends, or only before some of them, according to the type of round piece 11, the type of feed (from a reel, in bars, etc.), the uniformity of the section of the round piece 11, its provenance, the type of final product which is to be obtained, etc.

Claims

1. Perfected bending method for bending machines employed for the shaping of metal pieces, particularly, but not exclusively, for round pieces (11) used for reinforcement purposes, the bending machines including a working plane (19) cooperating with at least a drawing device (12) including one or more pairs of rolls (15), the rolls (15) having at least a working position ("I") wherein they are closed on the metal piece (11) in order to feed it forward, the drawing device (12) cooperating with at least one bending assembly (13b) arranged downstream of said drawing device (12) and with at least one shearing assembly (14), there also being included possible contrasting means and/or gripping means acting on said metal piece (11) at least during the bending step, the

method comprising the step of feeding and positioning at least one metal piece (11) in correspondence with the relative bending assembly, and the step of bending said metal piece (11), the method being **characterized in that**, before said bending step, the rolls (15) of the drawing device (12) are temporarily arranged in an open position ("II") where they do not interfere laterally and are not in contact with said metal piece (11) so as to allow the portion which is already bent and located after the bending assembly to fall onto the working plane (19), returning subsequently to the closed working position ("I"), so as to act as a contrasting element to the bending, before the at least one bending assembly (13b) acts on said metal piece (11).

2. Method as in Claim 1, **characterized in that** any of said contrasting and/or gripping means placed upstream or downstream said drawing device (12) also temporarily open so as to completely release said metal piece (11) from lateral contact.

3. Bending machine for metal pieces (11) comprising:

- a working plane (19),
- at least a drawing device (12) including one or more pair of rolls (15), the rolls (15) having at least a working position ("I") wherein they are closed on the metal piece (11) in order to feed it forward,
- at least a bending assembly (13a, 13b) arranged downstream of said drawing device (12),
- at least a shearing assembly (14) cooperating with said drawing device (12) and
- possible gripping and/or contrasting elements able to act on said metal piece (11) at least during the bending steps,

characterized in that

said rolls (15) of said drawing device (12) are adapted to be temporarily arranged in an open position ("II") where they do not interfere laterally and do not contact with said metal piece (11) and cause the already made and partially lifted bend to fall, due to their own weight, onto said working plane (19), and to return subsequently to the closed working position ("I"), so as to act as a contrasting element to the bending, before the at least one bending assembly (13b) acts on said metal piece (11).

4. Bending machine as in Claim 3, **characterized in that** it further comprises at least a limiting element (20) arranged downstream of the at least one bending assembly (13b), the limiting element (20) being arranged substantially on an axis with said metal piece (11) which is to be bent and including at least an upper face (20a) lying for a lengthwise segment on a plane at a defined height above the working

plane (19) of the bending machine (10) and defining between it and the working plane (19) a transit and containing space for said metal piece (11) which is to be bent and for the at least one bend defined therein.

5. Bending machine as in Claim 4, in which the upper face (20a) of the limiting element (20) is arranged at least temporarily substantially parallel to the working plane (19) of the bending machine (10).

6. Bending machine as in Claim 4, in which the limiting element (20) has an arched transverse development.

7. Bending machine as in claim 5 or 6, in which the limiting element (20) has a substantially rectangular transverse development.

8. Bending machine as in any claim hereinbefore from 4 to 7, in which the limiting element (20) is constrained pivoting horizontally with respect to the working plane (19).

9. Bending machine as in any claim hereinbefore from 4 to 8, in which the height of the limiting element (20) can be adjusted with respect to the working plane (19).

10. Bending machine as in any claim hereinbefore from 4 to 9, in which the limiting element (20) is associated with actuators (22) to move and/or discharge the limiting element (20) with respect to the working plane (19).

Patentansprüche

1. Optimiertes Biegeverfahren für Biegemaschinen, die zum Formen von Metallstücken verwendet werden, insbesondere aber nicht ausschließlich für Rundstücke (11), die zu Verstärkungszwecken verwendet werden, wobei die Biegemaschinen eine Arbeitsebene (19) umfassen, die mit mindestens einer Ziehvorrichtung (12), die eine oder mehrere Paare von Walzen (15) umfasst, zusammenwirkt, wobei die Walzen (15) mindestens eine Arbeitsposition ("I") aufweisen, in der sie auf dem Metallstück (11) geschlossen sind, um es nach vorn zuzuführen, wobei die Ziehvorrichtung (12) mit mindestens einer Biegeanordnung (13b), die stromabwärts von der Ziehvorrichtung (12) angeordnet ist, und mit mindestens einer Scheranordnung (14) zusammenwirkt, wobei auch mögliche Gegeneinrichtungen und/oder Greifvorrichtungen eingeschlossen sind, die auf das Metallstück (11) mindestens während des Biegeschritts wirken, wobei das Verfahren den Schritt einer Zufuhr und Positionierung mindestens eines Metallstücks

- (11) in Entsprechung mit der respektiven Biegeanordnung und den Schritt eines Biegens des Metallstücks (11) umfasst, wobei das Verfahren **dadurch gekennzeichnet ist, dass** vor dem Biegeschritt die Walzen (15) der Ziehvorrichtung (12) vorübergehend in einer offenen Position ("II") angeordnet sind, wo sie seitlich nicht einwirken und mit dem Metallstück (11) nicht in Berührung stehen, um zu ermöglichen, dass der Teil, der schon gebogen ist und hinter der Biegeanordnung angeordnet ist, auf die Arbeitsebene (19) fällt, wobei sie anschließend in die geschlossene Arbeitsposition ("I") zurückkehren, um als ein Gegenelement zum Biegen zu wirken, bevor die mindestens eine Biegeanordnung (13b) auf das Metallstück (11) wirkt.
2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** jegliche der Gegen- und/oder Greifvorrichtungen, die stromaufwärts oder stromabwärts von der Ziehvorrichtung (12) platziert sind, auch vorübergehend öffnen, um das Metallstück (11) von einer seitlichen Berührung vollständig freizugeben.
3. Biegemaschine für Metallstücke (11), umfassend:
- eine Arbeitsebene (19),
 - mindestens eine Ziehvorrichtung (12), die eine oder mehrere Paare von Walzen (15) umfasst, wobei die Walzen (15) mindestens eine Arbeitsposition ("I") aufweisen, in der sie auf dem Metallstück (11) geschlossen sind, um es nach vorn zuzuführen,
 - mindestens eine Biegeanordnung (13a, 13b), die stromabwärts von der Ziehvorrichtung (12) angeordnet ist,
 - mindestens eine Scheranordnung (14), die mit der Ziehvorrichtung (12) zusammenwirkt, und
 - mögliche Greif- und/oder Gegenelemente, die auf das Metallstück (11) mindestens während des Biegeschritts wirken können,
- dadurch gekennzeichnet, dass** die Walzen (15) der Ziehvorrichtung (12) angepasst sind, um vorübergehend in einer offenen Position ("II") angeordnet zu sein, wo sie seitlich nicht einwirken und mit dem Metallstück (11) nicht in Berührung stehen und bewirken, dass der bereits hergestellte und teilweise hochgehobene Bogen aufgrund seines Eigengewichts auf die Arbeitsebene (19) fällt, und um anschließend in die geschlossene Position ("I") zurückzukehren, um als ein Gegenelement zum Biegen zu wirken, bevor die mindestens eine Biegeanordnung (13b) auf das Metallstück (11) wirkt.
4. Biegemaschine nach Anspruch 3, **dadurch gekennzeichnet, dass** sie weiter mindestens ein Begrenzungselement (20) umfasst, das stromabwärts von der mindestens einen Biegeanordnung (13b) angeordnet ist, wobei das Begrenzungselement (20) im Wesentlichen auf einer Achse mit dem Metallstück (11), das zu biegen ist, angeordnet ist, und mindestens eine obere Fläche (20a), die für ein Längssegment in einer definierten Höhe über der Arbeitsebene (19) der Biegemaschine (10) auf einer Ebene liegt, umfasst und zwischen sich und der Arbeitsebene (19) einen Transit- und Umfassungsraum für das Metallstück (11), das zu biegen ist, und für den mindestens einen Bogen, der darin umgrenzt ist, definiert.
5. Biegemaschine nach Anspruch 4, bei der die obere Fläche (20a) des Begrenzungselements (20) mindestens vorübergehend im Wesentlichen parallel zur Arbeitsebene (19) der Biegemaschine (10) angeordnet ist.
6. Biegemaschine nach Anspruch 4, bei der das Begrenzungselement (20) eine gekrümmte querlaufende Entwicklung aufweist.
7. Biegemaschine nach Anspruch 5 oder 6, bei der das Begrenzungselement (20) eine im Wesentlichen rechteckige querlaufende Entwicklung aufweist.
8. Biegemaschine nach einem vorangehenden Anspruch von 4 bis 7, bei der das Begrenzungselement (20) in Bezug zur Arbeitsebene (19) horizontal schwenkend eingeschränkt ist.
9. Biegemaschine nach einem vorangehenden Anspruch von 4 bis 8, bei der die Höhe des Begrenzungselements (20) in Bezug zur Arbeitsebene (19) eingestellt werden kann.
10. Biegemaschine nach einem vorangehenden Anspruch von 4 bis 9, bei der das Begrenzungselement (20) mit Betätigungsvorrichtungen (22) verbunden ist, um das Begrenzungselement (20) in Bezug zur Arbeitsebene (19) zu bewegen und/oder zu entfernen.

Revendications

1. Procédé de pliage perfectionné pour des machines à plier utilisées pour façonner des pièces métalliques, tout particulièrement, mais non exclusivement, pour des pièces rondes (11) utilisées à des fins de renforcement, les machines à plier incluant un plan de travail (19) coopérant avec au moins un dispositif d'étirage (12) incluant une ou plusieurs paires de rouleaux (15), les rouleaux (15) comportant au moins une position de travail (« I ») dans laquelle ils sont fermés sur la pièce métallique (11) afin de la faire avancer, le dispositif d'étirage (12) coopérant

avec au moins un assemblage de pliage (13b) agencé en aval du dispositif d'étirage (12) et avec au moins un assemblage de cisailage (14), il peut également être inclus des moyens opposés et/ou des moyens de serrage agissant sur ladite pièce métallique (11) au moins au cours de l'étape de pliage, le procédé comprenant l'étape d'alimentation et de positionnement d'au moins une pièce métallique (11) en correspondance avec l'assemblage de pliage relatif, et l'étape de pliage de ladite pièce métallique (11), le procédé étant **caractérisé en ce que**, avant ladite étape de pliage, les rouleaux (15) du dispositif d'étirage (12) sont temporairement agencés dans une position ouverte (« II ») dans laquelle ils n'interfèrent pas latéralement et où ils n'entrent pas en contact avec ladite pièce métallique (11) afin de permettre à la partie déjà pliée et située au-delà de l'assemblage de pliage de tomber sur le plan de travail (19), revenant ensuite à la position de travail fermée (« I »), afin d'agir comme un élément opposé au pliage, avant qu'au moins un assemblage de pliage (13b) n'agisse sur ladite pièce métallique (11).

2. Procédé selon la revendication 1, **caractérisé en ce qu'un** quelconque desdits moyens opposés et/ou de serrage placés en amont ou en aval dudit dispositif d'étirage (12) s'ouvre également temporairement afin de libérer complètement ladite pièce métallique (11) d'un contact latéral.
3. Machine à plier pour des pièces métalliques (11) comprenant :
 - un plan de travail (19),
 - au moins un dispositif d'étirage (12) incluant une ou plusieurs paires de rouleaux (15), les rouleaux (15) comportant au moins une position de travail (« I ») dans laquelle ils sont fermés sur la pièce métallique (11) afin de la faire avancer,
 - au moins un assemblage de pliage (13a, 13b) agencé en aval dudit dispositif d'étirage (12),
 - au moins un assemblage de cisailage (14) coopérant avec ledit dispositif d'étirage (12) et
 - d'éventuels éléments de serrage et/ou opposés capâles d'agir sur ladite pièce métallique (11) au moins au cours des étapes de pliage,

caractérisée en ce que

lesdits rouleaux (15) dudit dispositif d'étirage (12) sont adaptés pour être temporairement agencés dans une position ouverte (« II ») dans laquelle ils n'interfèrent pas latéralement et n'entrent pas en contact avec ladite pièce métallique (11) et entraînent la chute du pliage déjà réalisé et en partie relevé, due à leur propre poids, sur ledit plan de travail (19), et pour revenir ensuite dans la position de travail fermée (« I »), afin d'agir comme un élément opposé au pliage, avant qu'au moins un assemblage

de pliage (13b) n'agisse sur ladite pièce métallique (11).

4. Machine à plier selon la revendication 3, **caractérisée en ce qu'elle** comprend en outre au moins un élément de limitation (20) agencé en aval d'au moins un assemblage de pliage (13b), l'élément de limitation (20) étant agencé sensiblement sur un axe avec ladite pièce métallique (11) à plier et incluant au moins une face supérieure (20a) reposant pour un segment de longueur sur un plan à une hauteur déterminée au-dessus du plan de travail (19) de la machine à plier (10) et définissant entre elle et le plan de travail (19) un espace de transit et de conteneur pour ladite pièce métallique (11) à plier et pour au moins un pliage défini dans celle-ci.
5. Machine à plier selon la revendication 4, dans laquelle la face supérieure (20a) de l'élément de limitation (20) est agencée au moins temporairement sensiblement parallèle au plan de travail (19) de la machine à plier (10).
6. Machine à plier selon la revendication 4, dans laquelle l'élément de limitation (20) comporte un développement transversal cintré.
7. Machine à plier selon la revendication 5 ou 6, dans laquelle l'élément de limitation (20) comporte un développement transversal sensiblement rectangulaire.
8. Machine à plier selon l'une quelconque des revendications ci-dessus 4 à 7, dans laquelle l'élément de limitation (20) est contraint de pivoter horizontalement par rapport au plan de travail (19).
9. Machine à plier : selon l'une quelconque des revendications ci-dessus 4 à 8, dans laquelle la hauteur de l'élément de limitation (20) peut être réglée par rapport au plan de travail (19).
10. Machine à plier selon l'une quelconque des revendications ci-dessus 4 à 9, dans laquelle l'élément de limitation (20) est associé à des vérins (22) pour déplacer et/ou décharger l'élément de limitation (20) par rapport au plan de travail (19).

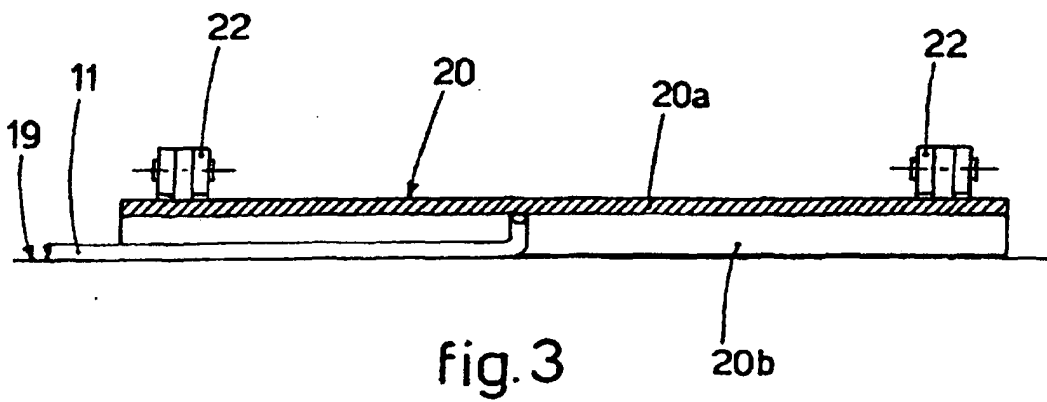
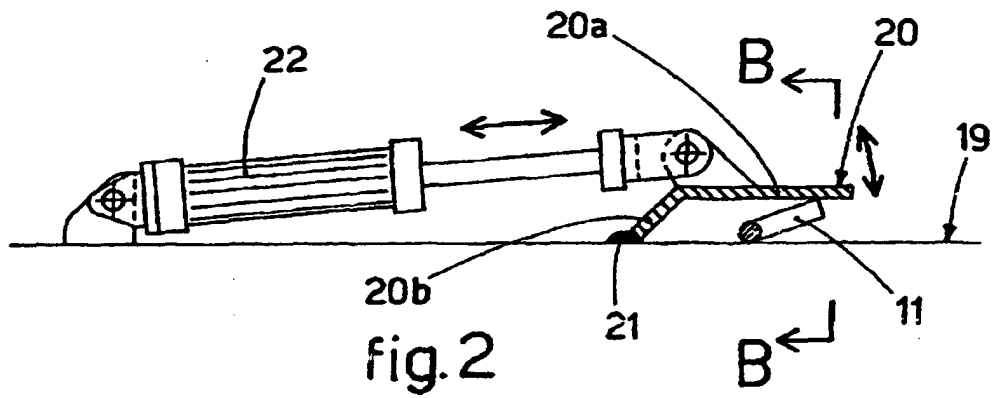
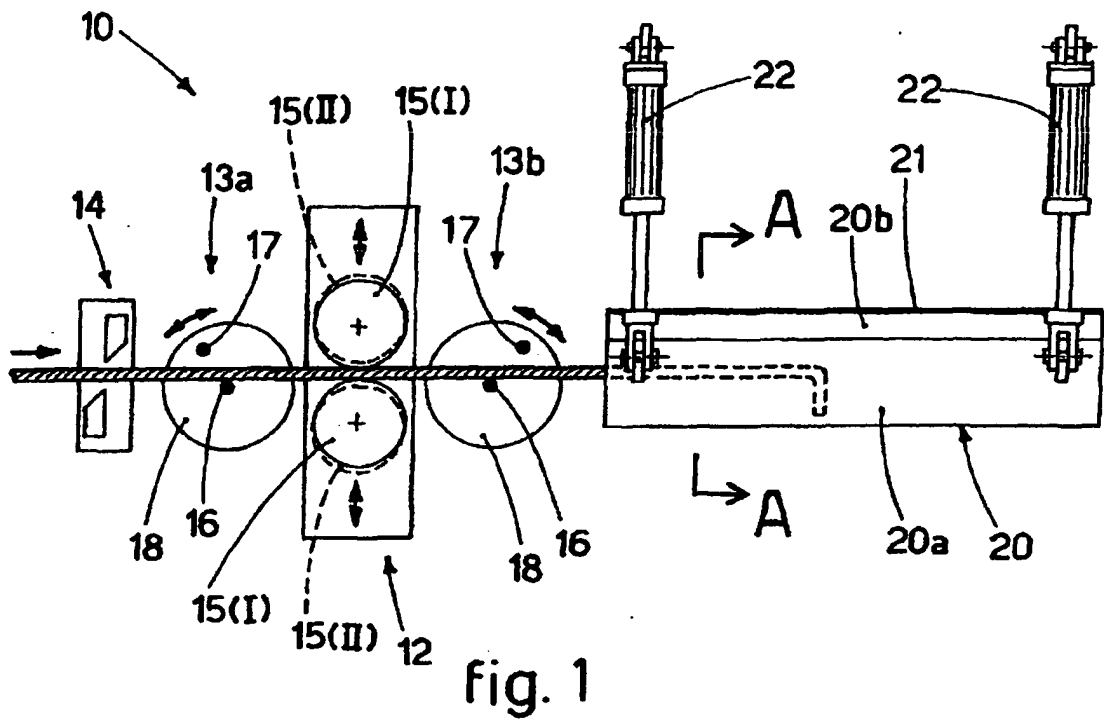
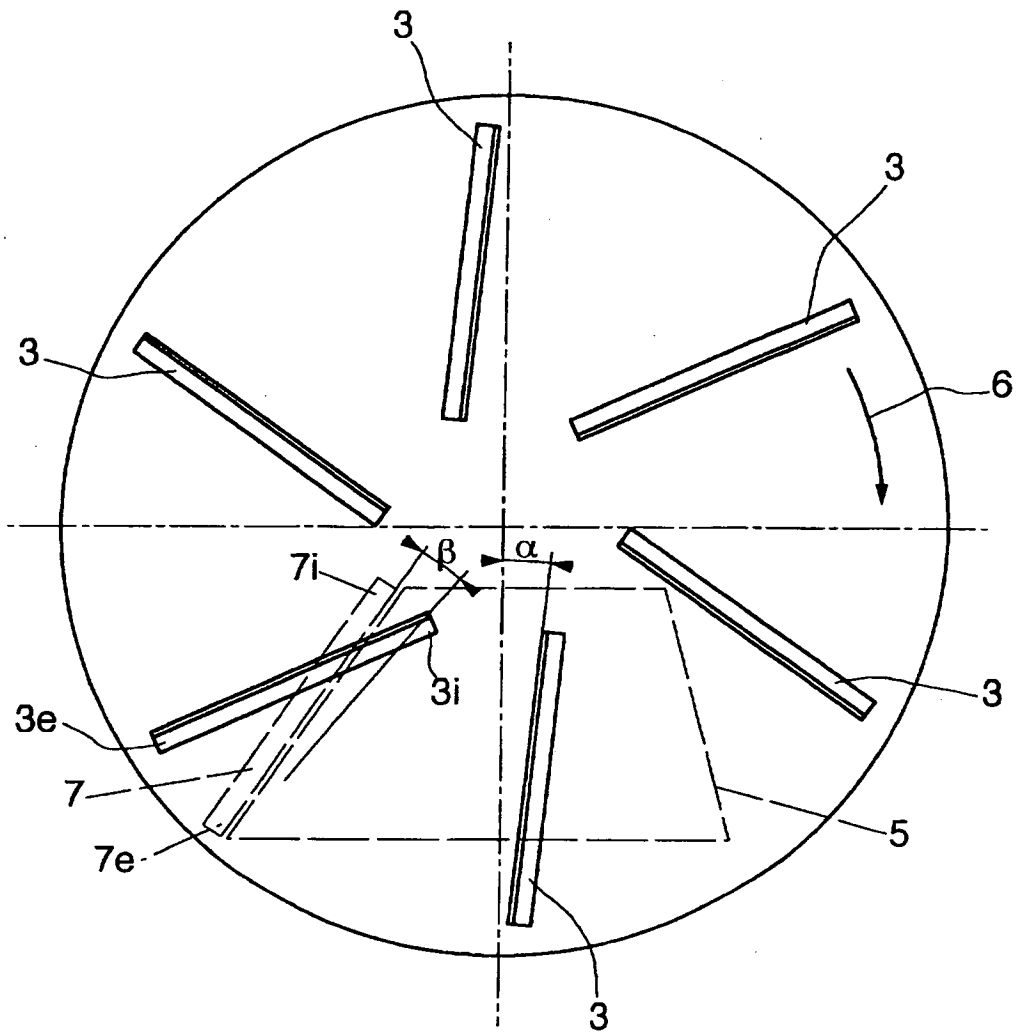


FIG.2



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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